

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH

TO : File

DATE: October 23, 1974

FROM : Special Assistant for Technology
OD, NHLI

SUBJECT: Conversations with Col. Hensley, Dr. John B. Walsh, and Vice Admiral Eli T. Reich at the Pentagon on October 17, 1974

The attached list of background items and questions was delivered a day early to Dr. Walsh. This made it possible for him to do nearly all of the talking during the 40 minutes of our interview without losing time making complicated explanations. Dr. Walsh is a Ph.D. electrical engineer, who is in charge of all U.S. military satellites. His message concerning systems engineering was essentially as follows.

Systems engineering works satisfactorily only if the basic technology is already known. Occasionally in the course of projects with which he has been concerned, basic investigation has been necessary. It was his reaction that if new knowledge were uncovered in this fashion, it was ordinarily a case of "lucking out." It was his estimate that when basic investigation is undertaken in a program which is run on a systems engineering basis, not more than ten or at the very most 20% of the undertakings are successful.

He pointed out that the costs of guiding a large project on the basis of systems engineering and the magnitude of the team which must be assembled to do so are ordinarily much too large for universities to handle. Systems engineering is therefore to be found almost exclusively in large corporations in industry. Sometimes in the course of work being done in this fashion by industry it is possible to break out pieces or areas which can be sublet to universities for the purpose of pursuing basic investigation.

In the program which is being handled on a systems engineering basis, it is not possible commonly for any one individual to grasp and to understand all of the details. The top level people, however, must understand all of the pieces in a somewhat general way well enough to be able to coordinate them.

It is common for the programs to be broken into pieces. Sometimes the manner in which this is done is rather arbitrary until experience is gained. When projects are broken into pieces for easier grasping and management, the major problem which arises is the interfaces between pieces. He used as an example one type of rocket which had an analog computer in it. In the course of development another was made which had a digital computer in it. In order to make these two devices work together it was necessary to have a DA convertor in one. Finally, both came to have digital computers and in order to have interchange, both were equipped with DA convertors until the process came along far enough so that they could have it all digital. This sort of problem becomes especially difficult when the programs get very large.

In regard to the development of the artificial heart, it was Dr. Walsh's opinion that an effort to use a systems engineering approach could hardly fail to result in disaster simply because so much basic investigation must be done which is not susceptible to successful attack by systems engineering.

DOD has problems with bureaucracy and personnel ceilings which Dr. Walsh thought were probably very similar to those at NIH. One mechanism which is employed to get around this difficulty of shortage of personnel and inadequacy of expertise was to seek a contractor who would use systems engineering and provide technical direction. Sometimes this technical direction is given directly to the contractors by the systems engineering concern and sometimes in the interest of maintaining control as well as possible the systems engineering concern gives advice to the military which then passes it along to consultants. This must be done on a continuing basis. TRW did this in developing the Minuteman rocket. Aerospace has done the same thing for DOD. The advantages of this arrangement are that these concerns can pay sufficient salaries to topnotch people who will do it right. He pointed out that the FCRCs (Federal Contract Research Centers) are on a guaranteed level of effort, and sometimes there is criticism of the arrangement because it looks to some like simply a way of getting around the Civil Service stipulations. The fear apparently is that top level people who have high salaries also are likely in government to have a great deal of power, and Dr. Walsh feels that this is a bad combination to give to individuals. In the case of the FCRCs, however, these people do not have much power inasmuch as the contracts can be terminated at any time at the pleasure of the government.

In the course of development of the Minuteman, at one time the Air Force turned the entire development over to the TRW. TRW then hired the necessary contractors and individuals to do the job. The tendency more recently has been to go back to utilization of TRW more as a continuously monitoring consultant with the actual giving of directions to contractors in the hands of members of the military.

At the present time the Army is using what are called technical assistance contracts in which experts from the contractor monitor carefully what is being done by the subcontractors or other contractors and guide the Army in making decisions as to changes.

In regard to the NHLI and having committees try to run big programs, Dr. Walsh has found that this is a road to fiasco. One such committee has been trying to run a large program in DOD. He did not feel that he was free to tell me what it was, but the running of the program has become just such a fiasco and it is even worse because the committee doesn't seem to have enough understanding to realize that it is a fiasco. His conclusion is that committees simply are not under any circumstances capable of running a systems engineering type of developmental work.

In view of the many problems that still exist in the effort to make an artificial heart, Dr. Walsh feels that this is probably still an area for the lone inventor or at least the independent investigator.

Dr. Walsh suggested repeatedly that it would be very fruitful for NHLI to get a group of top level systems engineers together to review the patterns of management of the program to develop an artificial heart. He suggested not more than six individuals and he thought that the appeal of trying to do something that would help mankind would perhaps offset the difficulties created by the smallness of the per diems offered by NIH.

Dr. Walsh made the following suggestions of individuals who might be appropriate top level systems engineers to have in such a study group. It will be noted that all of them come from industry. The reason is that no university is able to field a project running on a systems engineering basis.

Dr. Robert Burnette,	TRW
De Lauer,	(high officer in TRW, possibly president)
Oliver Boileau,	Boeing
Howard Burnette,	Lockheed
Dr. Seymour Seiberg,	Research & Development Associates on the West Coast
Robert Quade,	Rand Corporation (There was some question about him since he is not a systems engineer, but rather a systems analyst. Dr. Walsh thought he would either be extremely valuable or of no value at all, but nowhere between for some reason.)
Ivan Getting,	President, Aerospace Corporation

He thought someone from Bell Laboratories might very well be asked to come. The selection of a person from Bell might be put up to Brockway MacMillan, the vice president. He incidentally would be very much interested since he has just recovered from a rather severe myocardial infarction.

Col. Hensley and I stopped in to see Vice Admiral Eli T. Reich. Admiral Reich has had a great deal to do with systems engineering from the point of view of the military rather than from the point of view of the industrial people such as Dr. Walsh. In general, Admiral Reich appeared to concur in the messages which I had gotten from Dr. Walsh. Admiral Reich also drove home the point as Hensley and Walsh had done that systems engineering is not a fruitful pattern of management of basic investigation. (Admiral Reich was the commander of the submarine which sank the Japanese aircraft carrier Yamamoto during World War II.)

Admiral Reich suggested that it might be very fruitful to talk with Mr. John Riordan, a civilian GS 17 who has worked in the Pentagon for more than 20 years. Apparently he has a very great knack for the systems engineering approach. He serves now solely as a consultant for which purpose the DOD provides him with an office in the Pentagon. Col. Hensley will set this up for me.

ADDENDUM

With regard to the responses to the three questions on the attached sheet which was provided ahead of time to Dr. Walsh, the answer to question No. 1 as to whether it was feasible to bring truly top quality expertise in depth from outside NHLI into the day-to-day operation of the program is "yes," but he thought it was irrelevant. With regard to question No. 2, this appears to have been the subject of all of the discussion with Dr. Walsh. With regard to question No. 3, "Can a prime contractor take over the whole program making all subcontractors responsible to him" the answer was "no" with the addition that it would be perfectly all right and easily feasible if all of the technology were already in hand. Since the technology is not already in hand, this is not a fruitful course to take.

Background and questions to place before John B. Walsh, Ph.D.,
Deputy Director of Defense Research and Engineering (Strategic
and Space Systems)

1. The program on the artificial heart at NHLI is small
by the standards of DOD (about \$10 million in contracts).

2. The AH program at NHLI is run primarily by contracts
rather than grants, the thesis having been that the work of mul-
tiple contractors can be coordinated and directed from the NHLI.

3. There is insufficient expertise in depth in the staff
of NHLI to cover developments properly.

4. Expert task forces have been gathered to review initial
proposals and proposals for renewal, but they can meet only
periodically and cannot give continuing guidance. Furthermore,
in-house decisions can override the experts.

5. It appears probable that NHLI has failed to develop
contracts with the strongest investigators available. This may
well be related to the quality of monitoring which NHLI is able
to provide.

6. NHLI cannot acquire appropriate personnel in proper
depth or even fully use present personnel because of several
factors:

- a) Personnel ceilings imposed by the Administration,
- b) Proscription of performance of laboratory work on a continuing
basis by members of the staff dealing with extramural affairs of
NHLI, either in the laboratories of contractors or in laboratories
set up in the neighborhood of NHLI, a fatal obstacle to recruitment,
- c) Restrictive ceilings on salaries of high-level personnel,
- d) Time-consuming bureaucratic administrative nugacity,
- e) Widely spread geographical distribution of the contractors,
and, finally-
- f) Restrictive ceilings on the travel of the staff of NHLI im-
posed by the Administration, which limits the effectiveness of
even this staff in provision of properly close monitoring of
activities in the laboratories of contractors.

7. The above factors have contributed some distressing
extravagances and have been costly also in retardation of sound
progress.

QUESTIONS:

1. Is it in your view feasible to bring truly top quality
expertise in depth from outside NHLI into the day-to-day operation
of the program?

2. If so, in the light of your own experience in DOD,
how would you advise that we go about it?

3. Can a prime contractor take over the whole program,
making all other subcontractors responsible to him?

Oct. 16, 1974

C. Dennis, M.D., Ph.D.